Creating Energy Efficient Buildings & Communities

Urgent Need in Search of Policies

Peter Garforth
Principal – Garforth International llc

Energy Efficiency Technologies For Government Buildings – New and Retrofits
19th – 20th January 2005 – Chicago, Illinois

US Energy Background

- World's largest energy user - $1.1 Trillion
- Highest energy prices in US history
  - *Global levels*
- High energy intensity
  - *Twice European Union*
- Dependence on imports
  - *Oil (65%) and natural gas (1.5%)- rising fast*
- Uncertain climate change policies
  - *State level regulation emerging*
- China & India competing for primary fuels

Fundamental difference from past

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Large energy productivity differences

Region	Population	GDP	Energy Total	Energy / Capita	Energy / GDP
USA	100	100	100	***100***	***100***
EU-15	130	95	65	***50***	***66***
RoW	1910	94	246	13	261

Opportunity for best practice sharing

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**Various US/EU Sources – 2004 Est*

Wide range of energy performance *Homes and Buildings…*

- Commercial/Institutional Buildings
  - *Average US building uses up to 500 $kWh_e/m^2/yr$*
  - *New US buildings ~ 200 to 500 $kWh_e/m^2/yr$*
  - *New EU/CA buildings ~ 150 to 250 $kWh_e/m^2/yr$*
  - *Emerging low-energy practice ~ 45 to120 $kWh_e/m^2/yr$*

- Homes
  - *Average US home uses up to 500 $kWh_e/m^2/yr$*
  - *New US home uses 200 to 350 $kWh_e/m^2/yr$*
  - *New EU low-energy homes ~ 80 to110 $kWh_e/m^2/yr$*
  - *Net-Zero / Passive homes ~ 40 and 70 $kWh_e/m^2/yr$*

High efficiency potential

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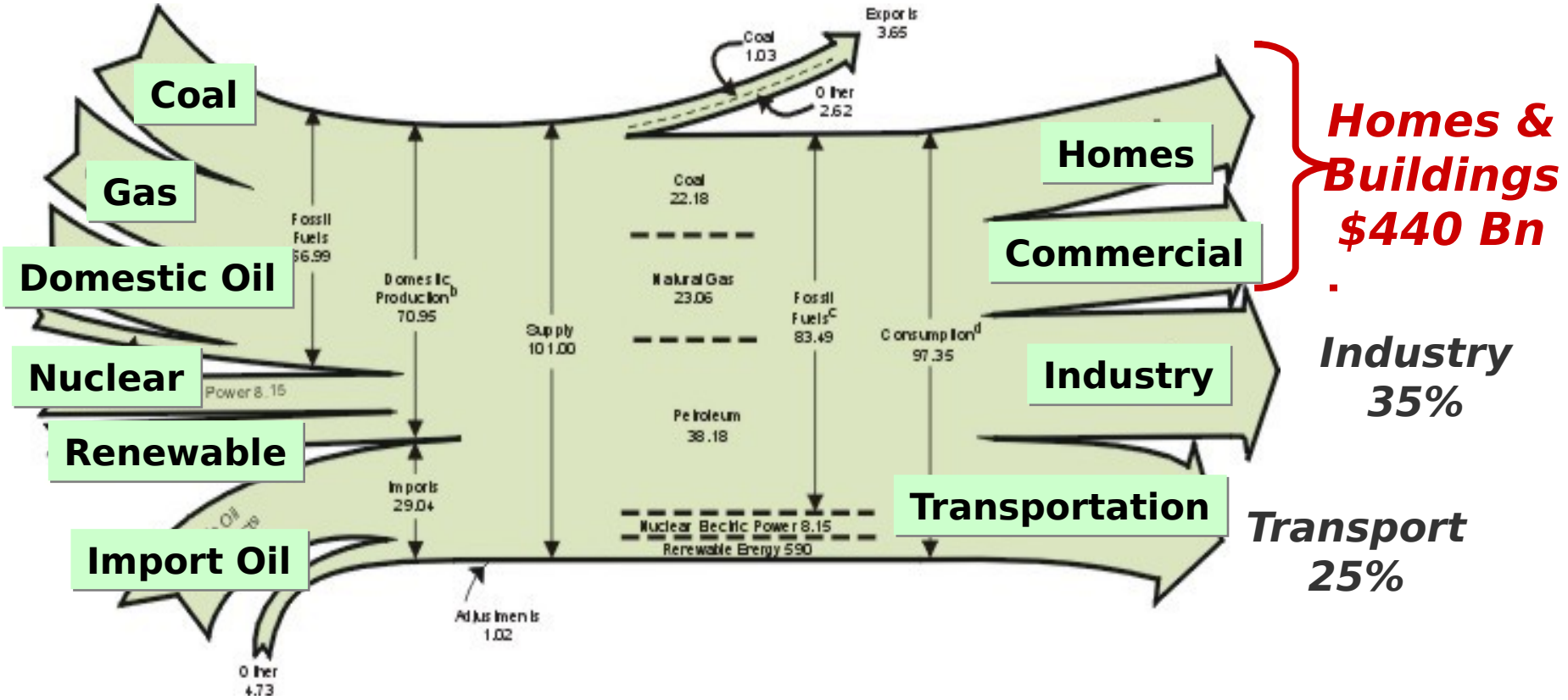
Total US Energy Use ~ $1.1 Trillion
Homes and Buildings largest users



Largest load is least efficient

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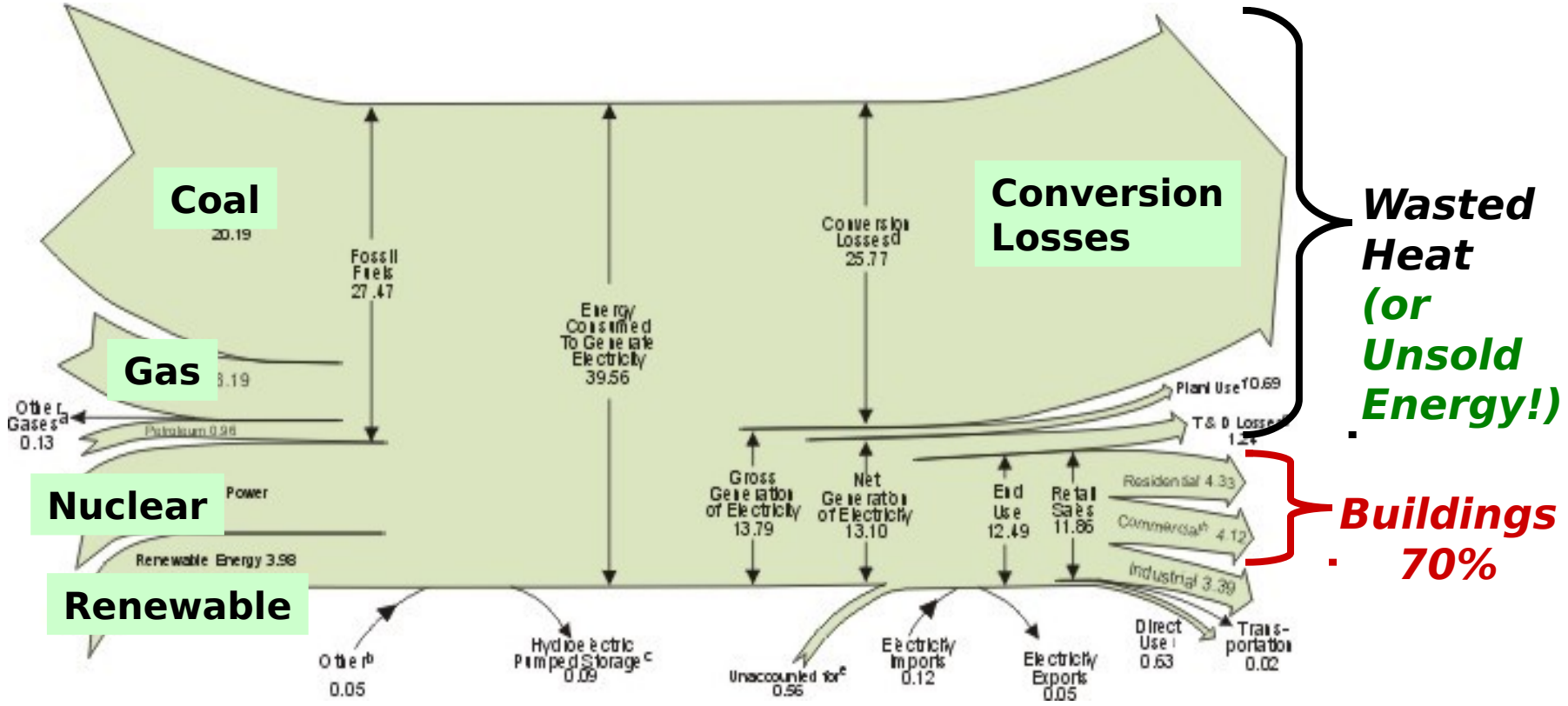
Source: US DoE

US Electricity demand
Homes and Buildings are 70% of total



Second largest cause of GHG

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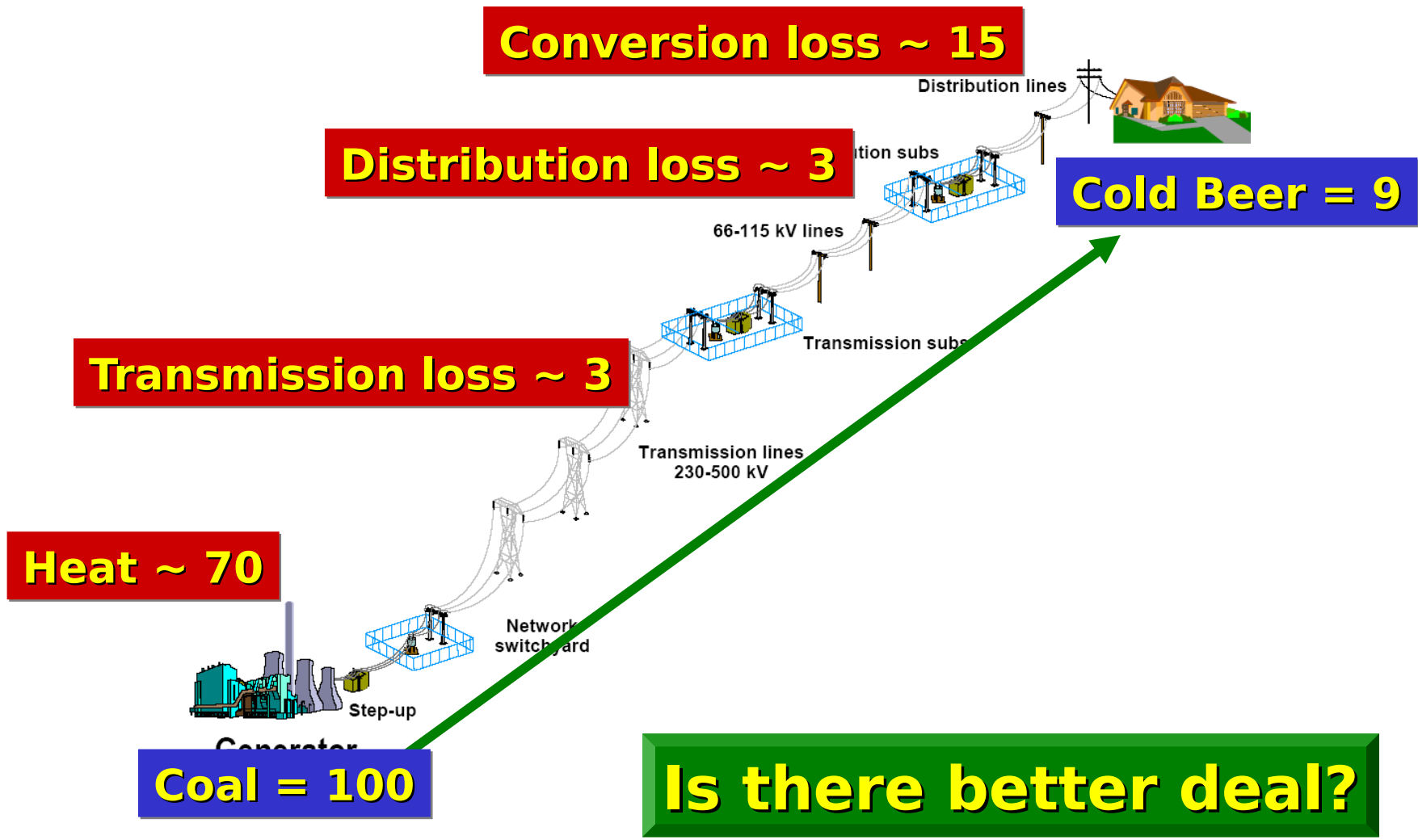
Source: US DoE

How much coal in cold beer?



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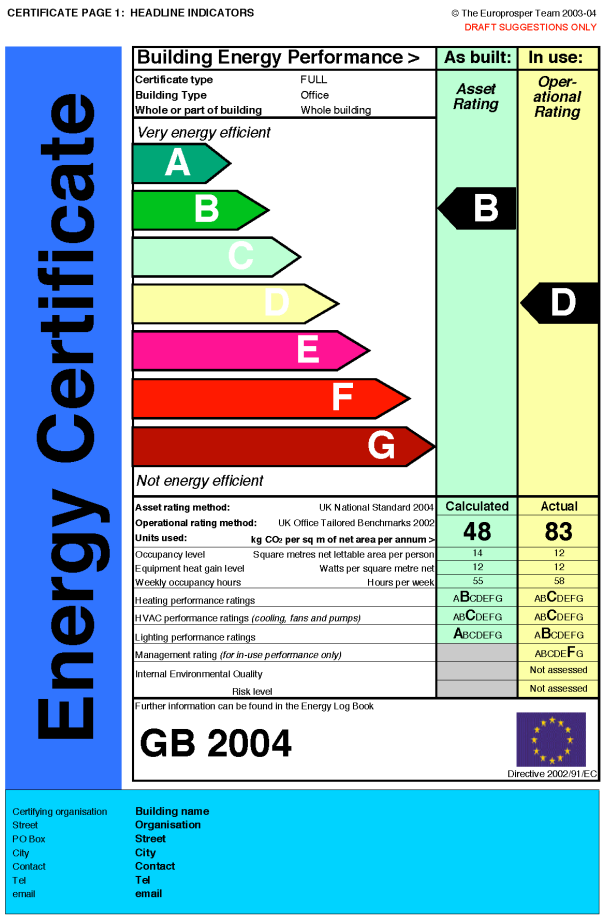
Building Performance Certification



CERTIFICATE PAGE 1: HEADLINE INDICATORS

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DRAFT SUGGESTIONS ONLY

Energy Certificate

Building Energy Performance >		As built:	In use:
Certificate type	FULL	*Asset Rating*	*Oper-ational Rating*
Building Type	Office		
Whole or part of building	Whole building		

Very energy efficient

A
B
C
D
E
F
G

Not energy efficient

		Calculated	Actual
Asset rating method:	UK National Standard 2004		
Operational rating method:	UK Office Tailored Benchmarks 2002	48	83
Units used:	kg CO_2 per sq m of net area per annum >		
Occupancy level	Square metres net lettable area per person	14	12
Equipment heat gain level	Watts per square metre net	12	12
Weekly occupancy hours	Hours per week	55	58
Heating performance ratings		ABCDEFG	ABCDEFG
HVAC performance ratings *(cooling, fans and pumps)*		ABCDEFG	ABCDEFG
Lighting performance ratings		ABCDEFG	ABCDEFG
Management rating *(for in-use performance only)*			ABCDEFG
Internal Environmental Quality			Not assessed
Risk level			Not assessed

Further information can be found in the Energy Log Book

GB 2004

Directive 2002/91/EC

Certifying organisation	**Building name**
Street	**Organisation**
PO Box	**Street**
City	**City**
Contact	**Contact**
Tel	**Tel**
email	**email**

- Simple
- Pioneered in Denmark
- Recommended in EU "Buildings Directive"
- Compared with peer group
- New buildings- Calculated
- Existing buildings - Actual
- Part of financing docs
- Stimulates innovation

Is this a Policy whose time has come?

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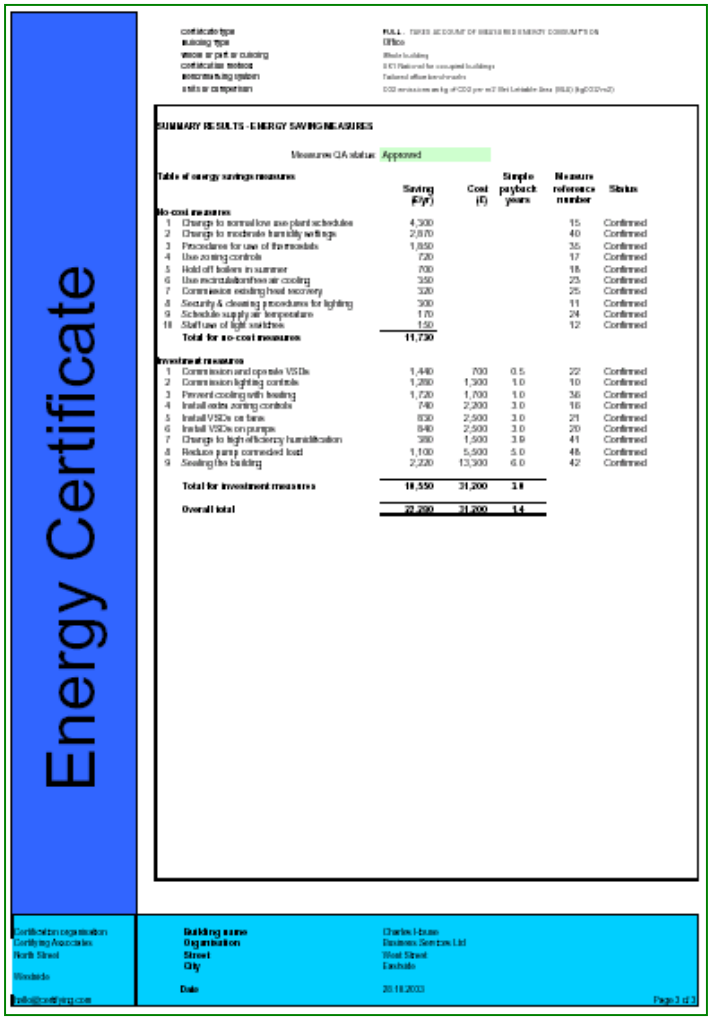
**Example Courtesy of R Cohen, E*

EPC* Pages 2 and 3: Energy Saving Measures/Methodology



Energy Certificate

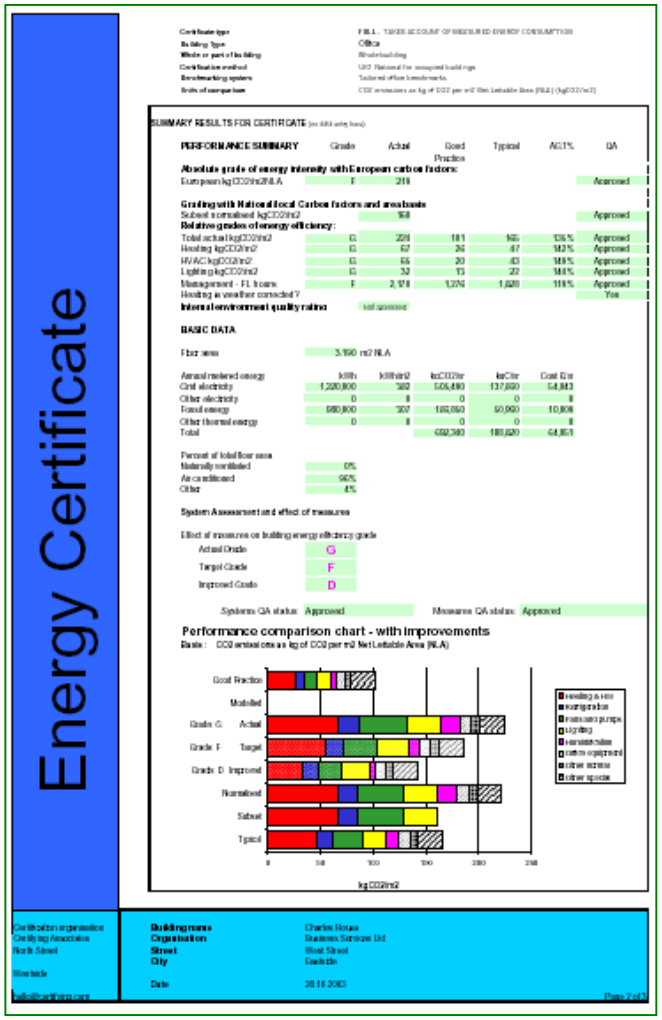
SUMMARY RESULTS - ENERGY SAVING MEASURES

Measures QA status: Approved

Table of energy savings measures

		Saving (£/yr)	Cost (£)	Simple payback years	Measure reference number	Status
No-cost measures						
1	Change to normal low ave plant schedules	4,300			15	Confirmed
2	Change to moderate humidity settings	2,870			40	Confirmed
3	Procedures for use of thermostats	1,850			35	Confirmed
4	Use zoning controls	720			17	Confirmed
5	Hold off boilers in summer	700			18	Confirmed
6	Use recirculation for air cooling	350			25	Confirmed
7	Commission existing heat recovery	320			25	Confirmed
8	Security & cleaning procedures for lighting	300			11	Confirmed
9	Schedule supply air temperature	170			24	Confirmed
10	Staff use of light switches	150			12	Confirmed
	Total for no-cost measures	**11,730**				
Investment measures						
1	Commission and operate VSDs	1,440	700	0.5	22	Confirmed
2	Commission lighting controls	1,280	1,300	1.0	10	Confirmed
3	Prevent cooling with heating	1,720	1,700	1.0	36	Confirmed
4	Install extra zoning controls	740	2,200	3.0	16	Confirmed
5	Install VSDs on fans	830	2,500	3.0	21	Confirmed
6	Install VSDs on pumps	840	2,500	3.0	20	Confirmed
7	Change to high efficiency humidification	380	1,500	3.9	41	Confirmed
8	Reduce pump connected load	1,100	5,500	5.0	46	Confirmed
9	Sealing the building	2,220	13,300	6.0	42	Confirmed
	Total for investment measures	**10,550**	**31,200**	**3.0**		
	Overall total	**22,280**	**31,200**	**1.4**		

Building name: Charles House
Organisation: Business Services Ltd
Street: West Street
City: Eastside
Date: 25.10.2003



Energy Certificate

SUMMARY RESULTS FOR CERTIFICATE

PERFORMANCE SUMMARY

	Grade	Actual	Good Practice	Typical	Act/%	QA
Absolute grade of energy intensity with European carbon factors:						
European kgCO2/m2/NLA	F	218				Approved
Grading with National/local Carbon factors and weekends						
Subset normalised kgCO2/m2		168				Approved
Relative grades of energy efficiency:						
Total actual kgCO2/m2	G	228	181	365	126 %	Approved
Heating kgCO2/m2	G	67	36	67	183 %	Approved
HVAC kgCO2/m2	G	66	20	63	348 %	Approved
Lighting kgCO2/m2	G	32	13	22	248 %	Approved
Management - FL hours	F	2,178	1,276	1,820	118 %	Approved
Heating is weather corrected ?						Yes
Internal environment quality rating	not assessed					

BASIC DATA

Floor area: 3,190 m2 NLA

	kWh	kWh/m2	kgCO2/yr	kgCO/yr	Cost £/yr
Annual metered energy					
Grid electricity	1,220,800	382	506,480	137,880	54,843
Other electricity	0	0	0	0	0
Fossil energy	680,800	207	182,050	50,960	10,806
Other thermal energy	0	0	0	0	0
Total			682,380	180,620	64,864

Percent of total floor area
Naturally ventilated: 0%
Air conditioned: 96%
Other: 4%

System Assessment and effect of measures

Effect of measures on building energy efficiency grade

Actual Grade	G
Target Grade	F
Improved Grade	D

Systems QA status: Approved Measures QA status: Approved

Performance comparison chart - with improvements

Basis: CO2 emissions as kg of CO2 per m2 Net Lettable Area (NLA)

Building name: Charles House
Organisation: Business Services Ltd
Street: West Street
City: Eastside
Date: 25.10.2003

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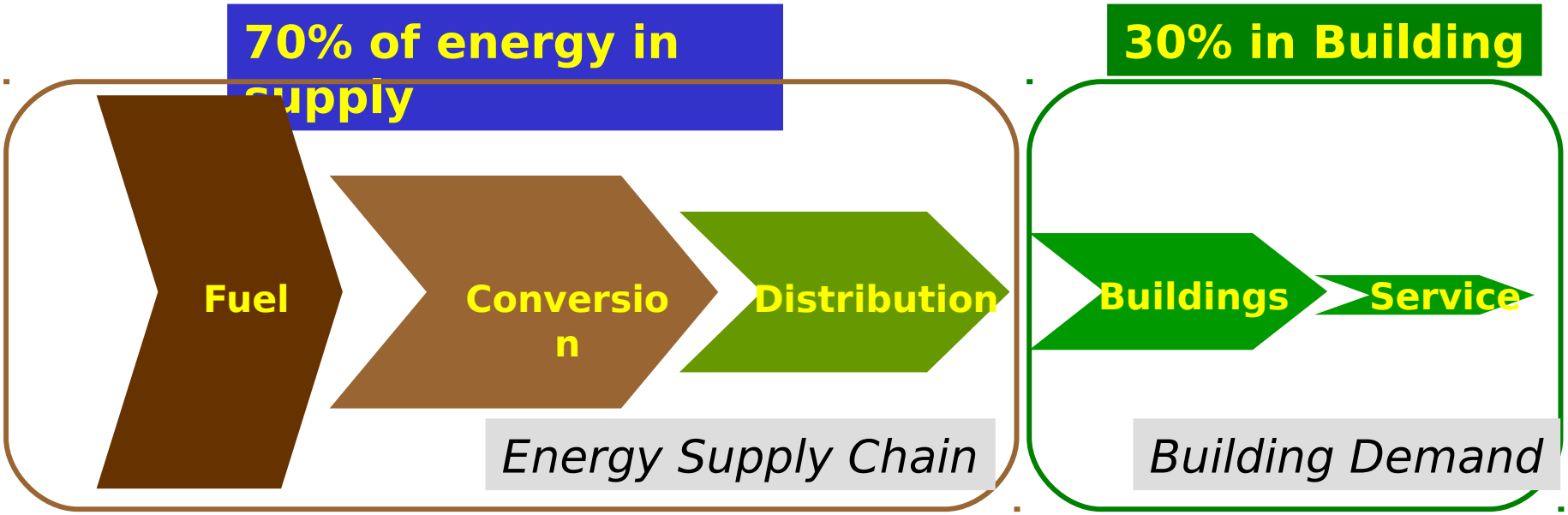
**Example Courtesy of R Cohen, ES*

Current Approach
Building efficiency only part of story



- Overwhelms renewable & cogeneration
- Rigid market structure and ownership
- High-cost approach with low returns

We pay for 100 and get 10

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University of Bremen
Engineering Building

80 to 100 $kWh_e/m^2/yr$

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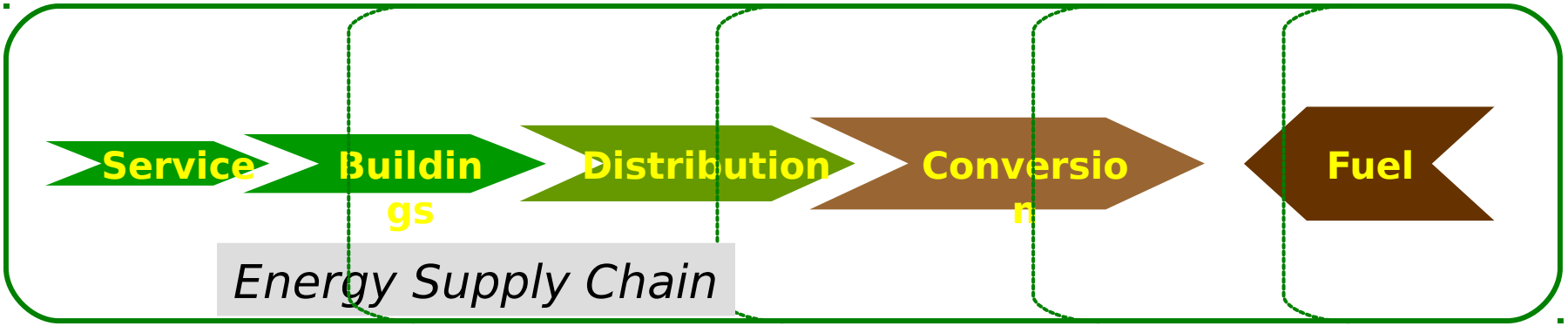
Integrated Energy Solutions
Rational approach for community systems

100% of Energy Chain



- "How much energy do I need for final service?"
- "What is optimum investment in efficiency and supply?"
- Results
  - *Least-cost approach with higher total returns*
  - *Major greenhouse gas reductions*
  - *Easier to integrate solar, wind, cogeneration…*

Pay for 100 and get 50 to 80!

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Campus Energy Supply
Waste to Energy (Heat and Power)

Cost and greenhouse gas reduction

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Energy Efficient Buildings in Efficient Community Settings

Mannheim, Germany
A city and its utility

- Population 350,000
- University town
- Industrial Base
  - *ABB*
  - *Siemens*
  - *Mercedes Trucks*
  - *BASF*
- Multi-utility structure
  - *District Heating/Cooling*
  - *Gas*
  - *Electricity*
  - *Water/Waste water*
  - *Mass transit*
- City/Private partnership

Over 116 years of evolution…

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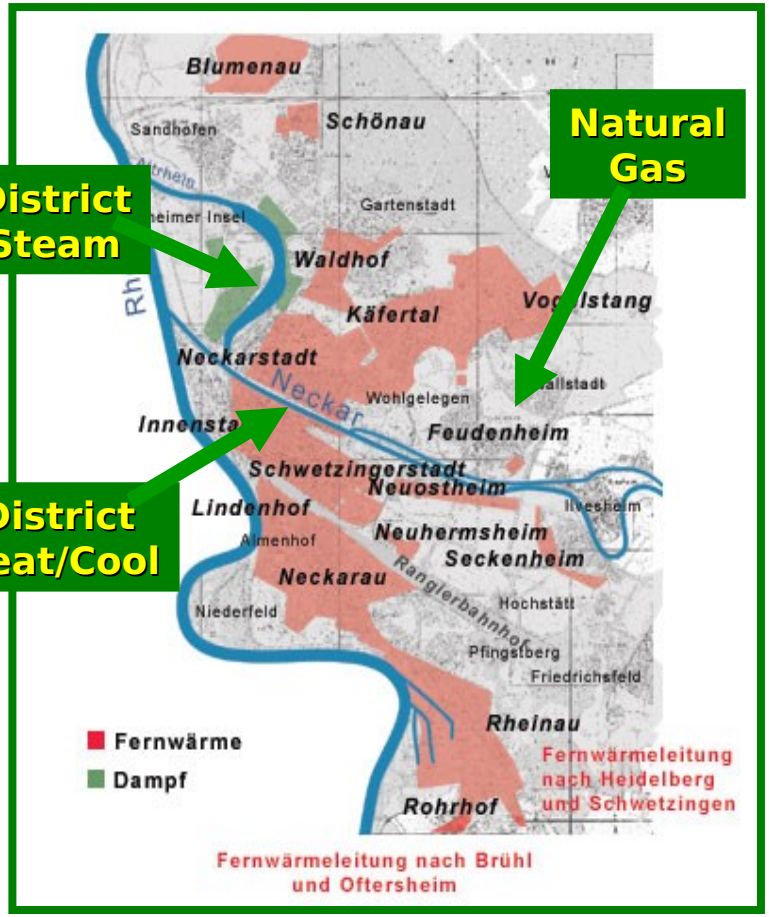
Example – City of Mannheim
Integrated Energy Approach



- "Load" Management
  - *Building efficiency*
  - *Industrial efficiency*
  - *Location/density*
  - *Mixed use – Live / Work*
- Energy zoning
  - *Steam*
  - *District energy (heat/cool)*
  - *Gas*
- Heat & Power sources
  - *Regional Gas/Electric Grids*
  - *2000 MW Coal generator with 80% heat recovery*
  - *Bio-mass generator*
  - *Waste to Energy plant*

Very low energy and CO2 density

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Covell Village CEC Study
Teamed Global/Local Skills

TANDEM INC.

Sensitive development

Municipal energy leader

Building efficiency experts

DAVIS ENERGY GROUP INCORPORATED

California energy expertise

Major utility

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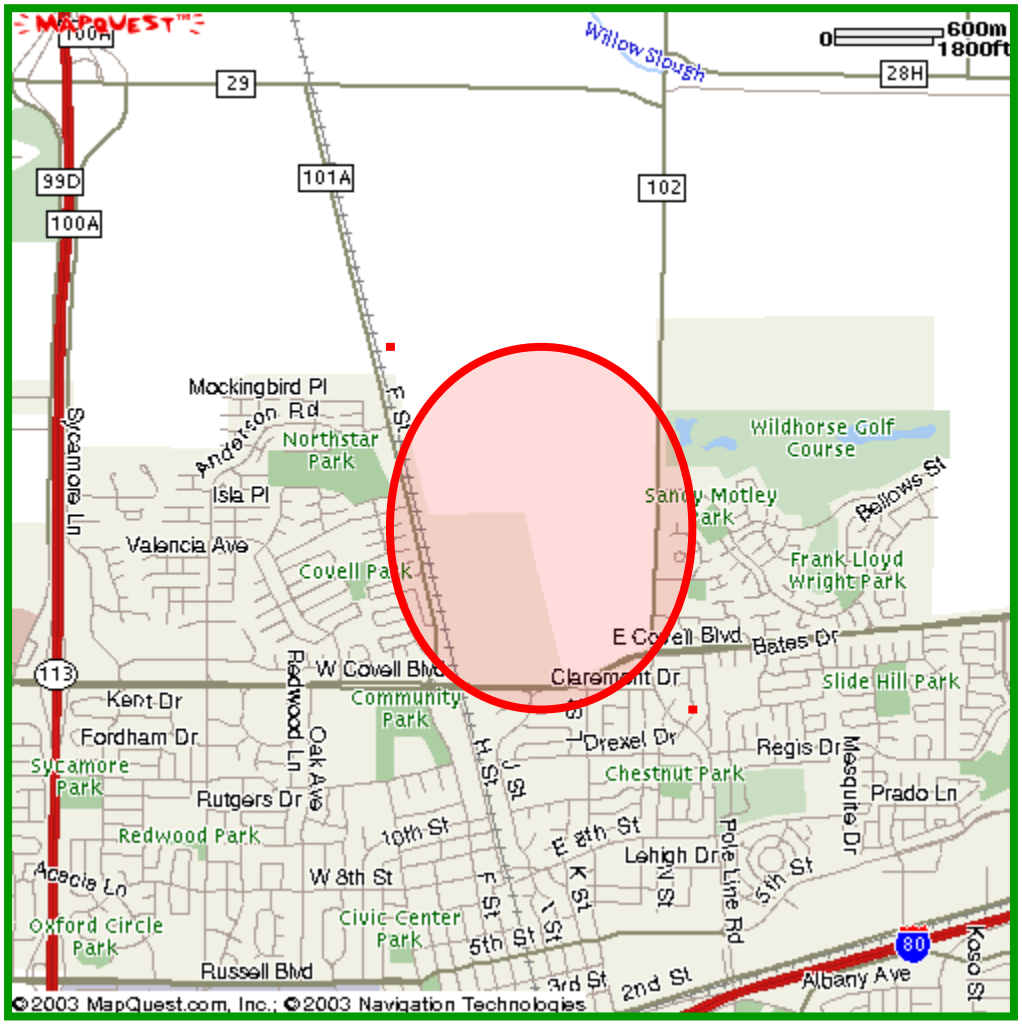
Covell Village - California
Scale of a new "village"



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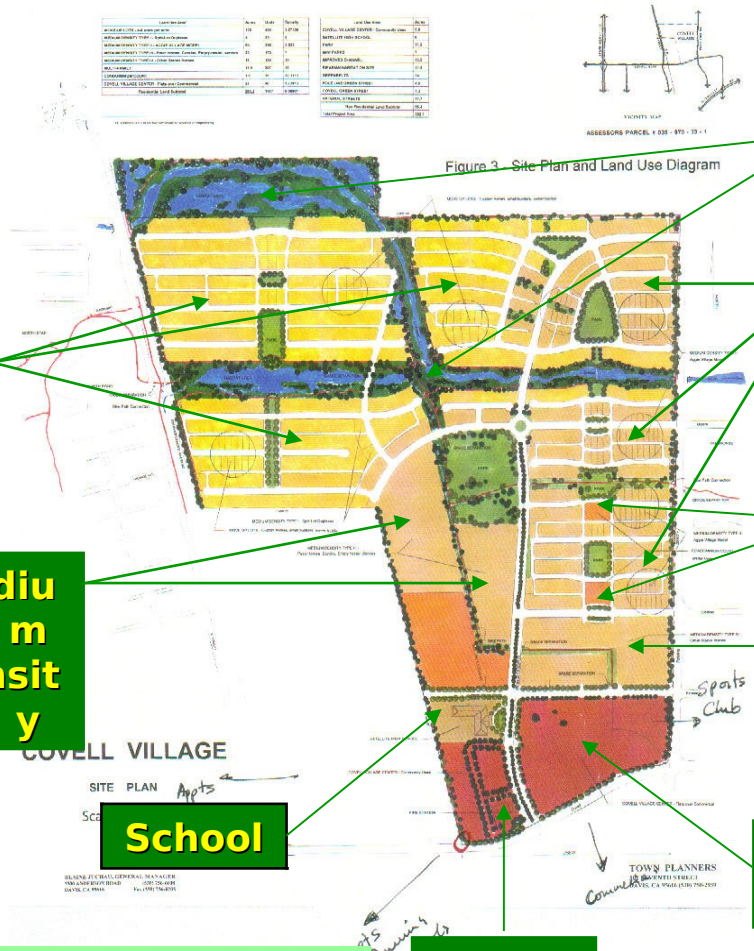
European Style Village
Low resources – Maximum livability



Water Habitat

Medium Density

Move-up Lots

Condos

Medium Density

Starter Homes

School

Village Center

Fire Station

- **Starter Homes - 180**
- **Multi-family - 207**
- **Condos - 25**
- **Flats- 40**
- **Medium Density - 555**
- **Move-up Lots - 455**

Area 383 Acres

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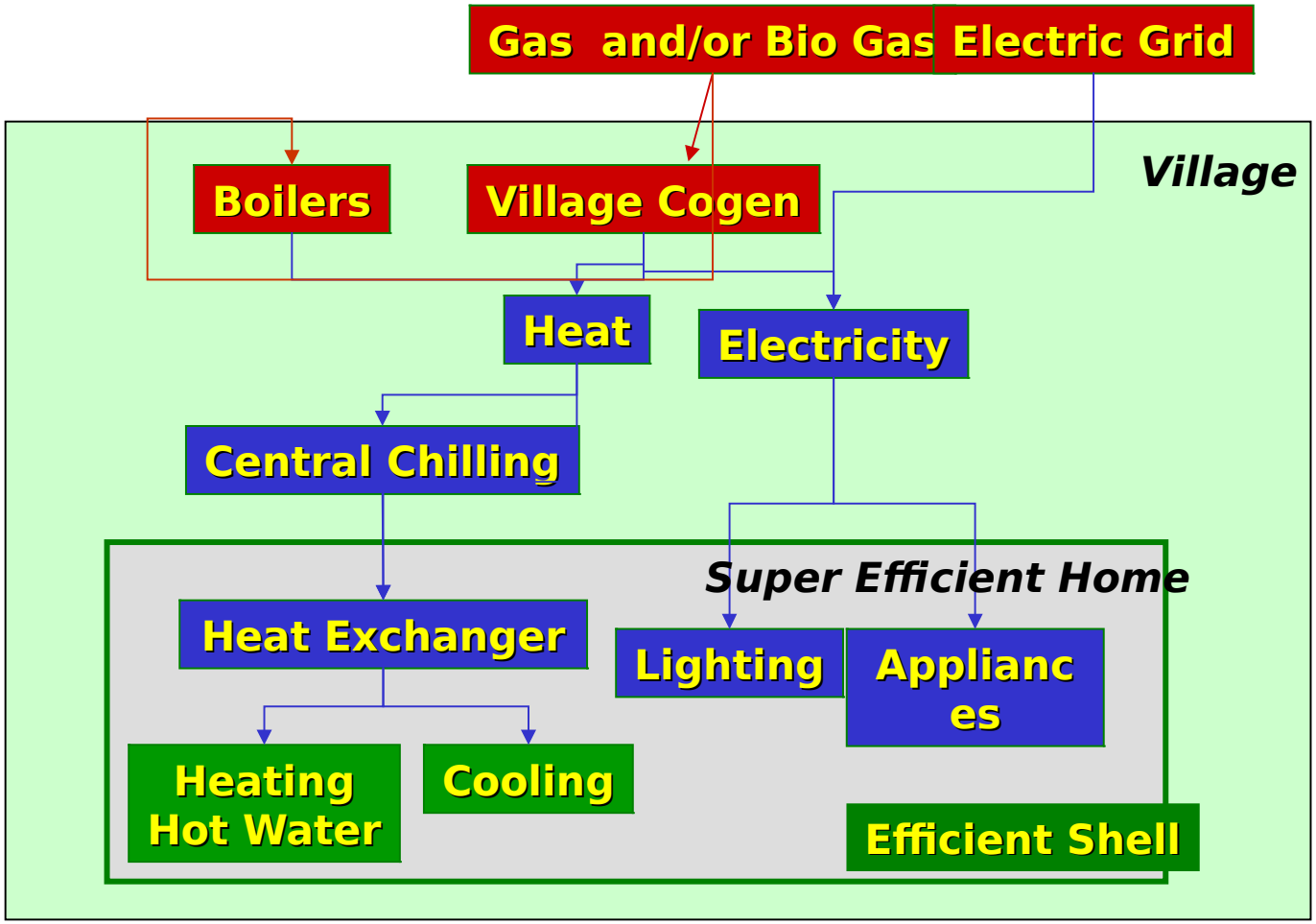
Energy System Evaluated



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Covell Village Study Conclusions
Economic and environmental benefits

- Combination
  - *Efficient buildings*
  - *Renewable solar thermal*
  - *Local combined heat and power generation*
  - *Team with electric and gas grids*
- Results
  - *Less costs for builder*
  - *Reduced energy cost for owner*
  - *Massive reduction electrical peak*
  - *Improved utility business returns*
  - *Improved energy supply reliability*
  - *Massive reduction in greenhouse gas emissions*

“Community” Energy Plan Benefits

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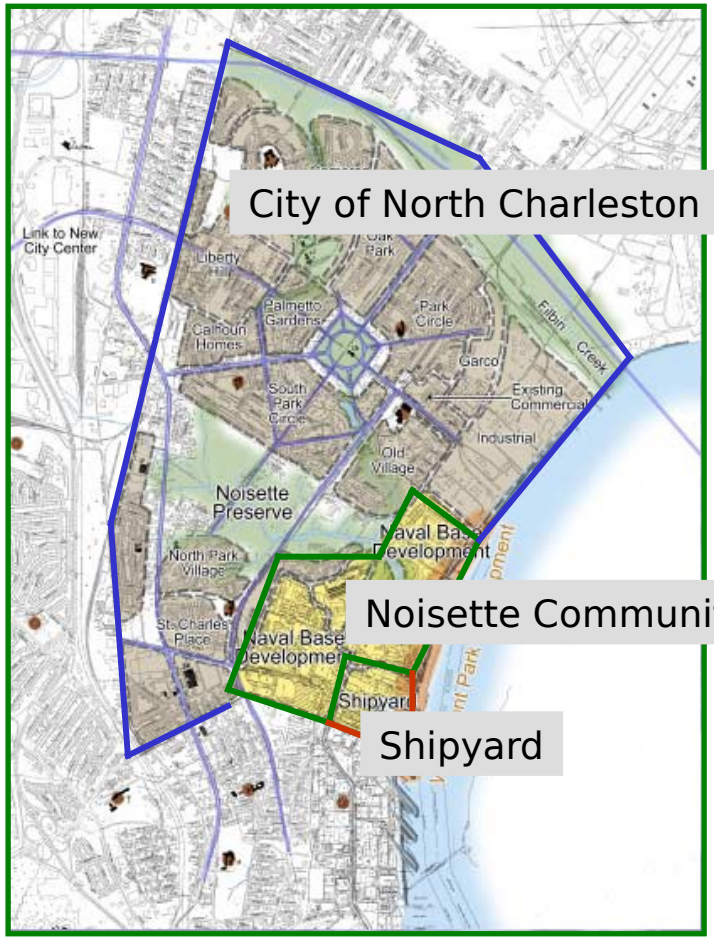
Charleston Navy Base/Noisette Community
Driven By Motivated Developer



- Redevelop as sustainable community
- 5000 plus homes, 6M sq ft commercial
- Community plan includes vision for entire City of North Charleston
- Integrated energy master planning team being formed
  - *US/EU Expertise*
  - *Local utility*
  - *Developer*

Breakthrough energy performance targets

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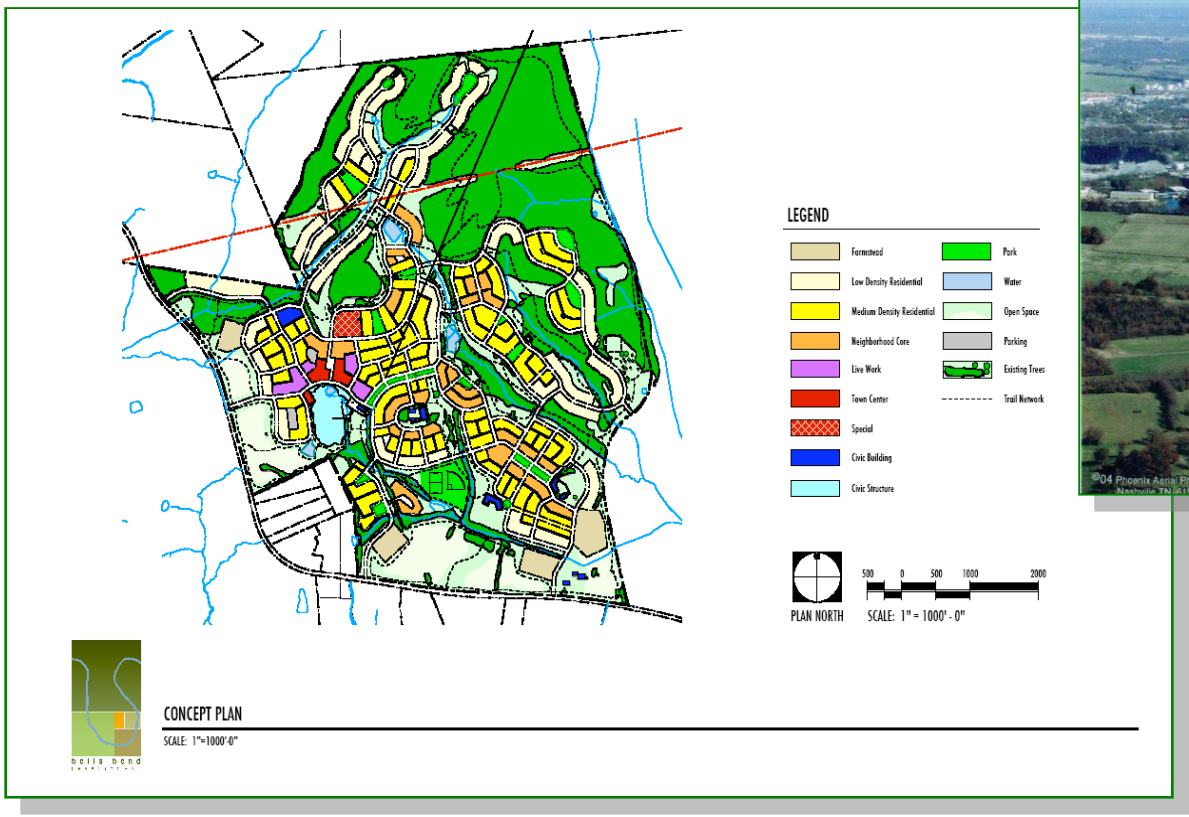
Visions of the Future
Bell's Landing, Nashville, Tennessee



"Build Community not housing"

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Energy Goals
Driven by Motivated Developer

PRE-CHARRETTE EDITION

BELLS LANDING

What's A Charrette?

Citizens at a charrette help plan the design of their community.

Bells Landing Charrette Schedule

A Message from the Developer

A Vision for a Great Neighborhood

By Jeff Zeitlin
Bells Landing Group, LLC

A view of downtown Nashville from Bells Landing.

www.bellslanding.info

- *Higher quality, reliability*
- *Lower energy costs*
- *30 to 50% higher efficiencies*
- *40 to 60% less greenhouse gas*
- *Flexibility to accommodate future technologies*
- *Competitive construction costs*
- *Premium market prices*
- *Energy performance certificates*
- *Planned for 10 year build out*

Planning Request in Process

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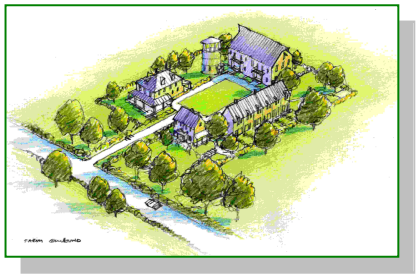
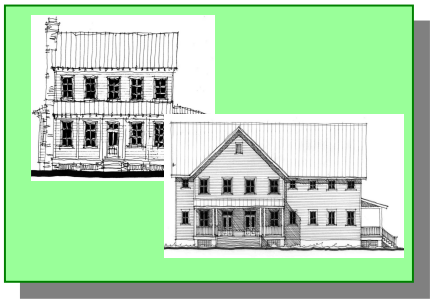
Tailored community energy solutions
Optimized by Building Groups

Village Clusters

- Zoned energy efficiency
- Supply solutions optimized by type
- Supply portfolio
  - *Renewable*
  - *Co-generation*
  - *Heat pumps*
  - *Biomass*
  - *Procured green electricity*
  - *Grid gas/electric*
- Community utility business model



Homestead Condos



Single Homes

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Multiple Benefits
Energy efficient urban developments

Home Buyer

- *Reduced costs*
- *Resale value*
- *Mortgage size*

City

- *Attractive development*
- *Premium taxes*
- *Environmental impact*
- *Competitive energy servi*

Utility

- *Higher returns*
- *Emissions credits*
- *Customer intimacy*
- *Diversification*

Commercial

- *Reduced costs*
- *Rental values*
- *Low vacancy*
- *Productivity*

Site Developer

- *Premium prices*
- *Low carrying time*
- *Reduced investment*

Banks

- *Collateral Value*
- *Ability to pay*

Can we rely on motivated developers?

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Policy Frameworks
Urgent need to change the game

- Integrated energy planning approaches essential
- Leadership needed
  - *Government/Military Agencies*
  - *Military facilities*
  - *Municipalities*
  - *Universities*
- Focus on large-scale dense developments
  - *Brown field redevelopment*
  - *New Urbanism/Village style development*
  - *Sports facilities*
  - *School and College Campuses*
  - *Government / Military sites*
  - *Major commercial or industrial development*
- Build community plan to “connect the dots”

Efficient Cities are Competitive Cities

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New Guidelines for Planning Permits

- Project specific energy efficiency and GHG zoning
- Energy Performance Certification
- Multi-year Energy Master Plan required
  - *Energy use profiles over build out of project*
  - *Greenhouse gas creation profiles*
  - *Energy supply strategy*
    - *Renewable*
    - *Distributed co-generation*
    - *District energy*
    - *Natural gas/bio-fuel*
    - *Energy efficiency*
    - *Grid gas /electricity*
  - *Operating approach*
    - *Energy service system ownership & operating structure.*

Cannot rely only on motivated developers

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Integrated Community Energy Solutions
Benefits and Challenges

Benefits

- Quality buildings
  - *High resale/rental value*
  - *Low energy/other costs*
  - *Similar cost to build*
- Eliminates electric peak
- Environmental impact
  - *At least 1/3rd emissions*
  - *Low energy footprint*
- Supply reliability rises
- Optimized investment
  - *Efficiency/Supply*
- Tailored solution
- Financial attractiveness
  - *Return on energy assets*

Challenges

- Project scale
  - *Business complexity*
  - *Custom solution*
- Inertia
  - *Construction practice*
  - *Utility practice*
  - *Legal - Regulatory*
- Ownership boundaries
  - *Grids*
  - *Local energy systems*
  - *Buildings*
- Myths and perceptions
  - *Too expensive, difficult, risky…*

Can we afford to miss the benefits?

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Thank You

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